

Bettis Canada Ltd. 4112 91A Street Edmonton, Alberta, Canada T6E 5V2

Tel: (780) 450-3600 Fax: (780) 450-1400 **EDMONTON**

Service Manual

BETTIS J1-RT2 RATE OF DROP LINEBREAK DETECTION SYSTEM

CUSTOMER:
P.O.#:
W.O.#:
TYPE:
DATE:
FACTORY SET: psi/min RoD @psi P/L
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SECTION I GENERAL DESCRIPTION & INFORMATION

The Bettis J1-RT2 system is designed to automatically monitor a gas pipeline, and deliver a pneumatic signal if a pre-determined rate of pressure drop is exceeded. The unit is typically used to detect a pipeline break situation and signal a valve operator.

The system consists of a rate tank, J-1 differential pressure pilot, restrictor, check valve, manifold assembly and associated tube, fittings, gauges and filters.

The system works as follows: when pipeline pressure is rising, gas flows through the check valve and restrictor, into the rate tank. When pipeline pressure is falling, gas flows out of the rate tank, back to the pipeline through the restrictor only. The restrictor resists the flow creating a pressure drop which is sensed by the J-1 as differential pressure. The J-1 will send a pneumatic signal if the differential pressure exceeds its calibrated setting. The greater the rate of drop in the pipeline pressure, the greater the differential pressure across the J-1. The following abbreviations will be used:

pipeline pressure P/L rate of drop RoD differential pressure ΔP

Normally, the pipeline will be operating at a steady or slowly changing pressure. When a pipeline break occurs, the RoD at the J1-RT2 sensing point will depend on the distance to the break. Greater distance to the break will decrease RoD at the sensing point. A compromise must be made in adjusting the RoD setpoint. It must be as low as possible to detect remote breaks, but not so low that normal pipeline pressure fluctuations will cause a false alarm.

As indicated earlier, the J-1 differential pressure pilot does not respond directly to RoD but to ΔP . The ΔP depends on RoD, but also on:

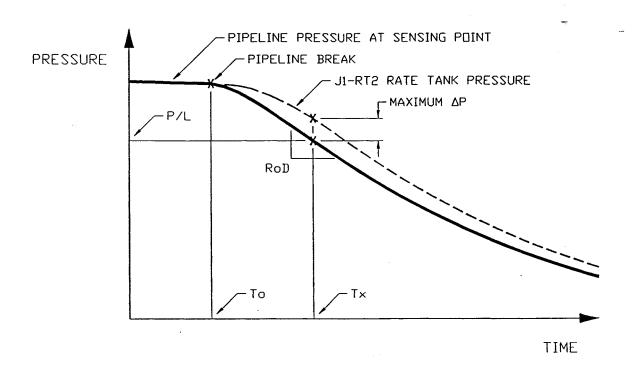
- 1. P/L: The RoD required to generate a given ΔP increases with higher P/L.
- 2. Time: After the initiation of a RoD due to a pipeline break the ΔP takes time to reach its maximum value.

These dependencies are inherent in this type of system. The time delay in reaching the maximum ΔP necessitates the following clarification:

P/L is the pipeline pressure occurring at the time that the maximum ΔP is developed, not the pipeline pressure at the initiation of the RoD (refer to FIG 1). This time delay is apparent and accounted for in the FUNCTION CHECK procedure (SECTION IV).

SECTION I GENERAL DESCRIPTION & INFORMATION - continued

FIGURE 1 shows the characteristic pressure versus time relationship of the system. If the RoD shown was the SETPOINT RoD, then the maximum ΔP shown would be equal to the J-1 ΔP SETPOINT. The J-1 would switch (ie. "trip") and send a pneumatic alarm signal at time Tx. If the RoD shown was slightly below the SETPOINT RoD, then the maximum ΔP shown would be less than the J-1 ΔP SETPOINT, and it would not switch (no matter how much time passed). If the RoD shown was higher than the SETPOINT RoD, the ΔP would reach the J-1 ΔP SETPOINT before time Tx.



CHARACTERISTIC PRESSURE VERSUS TIME RELATIONSHIP FOR J1-RT2

SECTION I GENERAL DESCRIPTION & INFORMATION - continued

Each combination of restrictor and rate tank size has a specific CALIBRATION CHART (Refer to FIG 6), identified by a TYPE number which corresponds to the TYPE number stamped on the unit name plate.

The CALIBRATION CHART maps the relationship between ΔP , RoD and P/L. The J-1 pilot is calibrated to trip at a particular ΔP by adjusting the spring preload or changing springs. The CALIBRATION CHART also indicates the ΔP ranges of the four J-1 springs which may be used (stocked at the factory). The selection of restrictor is done at the factory based on the specified RoD range and P/L operating range. Specific instructions for reading the required ΔP from the CALIBRATION CHART are given in Section III (4. J-1 ΔP CALIBRATION).

The CALIBRATION CHARTS are for natural gas with a specific gravity (SG) of .67 and temperature of 20°C. After correcting for SG and temperature, they will normally agree with field data within ±20% (on RoD). The inaccuracy is due to manufacturing tolerances and the fact that the chart P/L lines are adjusted from original data using air. Considering the above, the recommended uses of the CALIBRATION CHARTS are limited to the following:

- Selection of the correct restrictor for an application (normally done at the factory).
- Initial J-1 pilot calibration (normally done at the factory), to be verified at final installation using the FUNCTION CHECK procedure (Section IV).
- Illustration of performance characteristics for training, calibration or troubleshooting purposes.

Use of the CALIBRATION CHARTS to verify FUNCTION CHECK data is not recommended as it is complicated, (Corrections would generally have to be made for SG and temperature) and unnecessary, (the data from the FUNCTION CHECK procedure, stands by itself as proof that the system is operating to specification, provided the unit has been calibrated and tested per Section III).

It is recommended that users establish their own baseline calibration records using the procedures in Section III and IV and keep calibration records.

SECTION II INSTALLATION AND START-UP

GENERAL INFORMATION

The unit can be installed remote from or on the valve operator. The following preparations are required:

- 1. Ensure the isolation valve on the pipeline is installed with take-off to top of pipeline to allow liquids to drain back into the line.
- 2. Ensure that pipe and tube to be used is free of chips and debris.
- 3. Use minimum 1/4 NPT or 3/8 tube, with support adequate to prevent vibration and strain on connections.

An additional pre-filter is recommended (Refer to Section VI, item 4). It should be installed between the PIPELINE ISOLATION VALVE (FIG 4, item 101), and the customer supplied isolation valve at the pipeline take-off.

CONNECTIONS (Refer to FIG 3)

When the J1-RT2 System is shipped pre-installed on the valve operator, customer connections consist of:

- High pressure pipeline gas connection to PIPELINE ISOLATION VALVE (pipeline connection "A", 1/4 NPT female).

When the J1-RT2 System is shipped separately, customer connections, in addition to above, include:

- Low pressure supply connection to J-1 pilot valve (supply connection "C", ¼ NPT female, 150 psig max).
- Low pressure signal connection to J-1 pilot valve (signal connection "B", ¼ NPT female).

SECTION II INSTALLATION AND START-UP - continued

START UP (Refer to FIG 4)

1. OPERATION AND FUNCTION OF MANUAL VALVES

- a. PIPELINE ISOLATION VALVE (item 101): This valve is normally open. Closing this valve isolates the system from the pipeline.
- b. RATE TANK DRAIN VALVE (item 107): This valve is normally closed and plugged. Unplug and open to depressurize the J1-RT2 system or drain condensate.

2. START-UP

- a. Check and close all manual control valves.
- b. Open the main isolation valve on the pipeline (customer supplied).
- c. SLOWLY open PIPELINE ISOLATION VALVE (item 101) to pressurize system.
- d. When flow into the RATE TANK has stopped, the signal pressure gauge should indicate if a signal is being applied to (or removed from) the valve operator control package.
- e. The Line Valve (item 2) should be able to be opened and it should remain open.

LEAK TEST ALL FITTINGS AND CONNECTIONS WITH SOAPY WATER.

SECTION III CALIBRATION AND TESTING

THREE REQUIREMENTS FOR CORRECT J1-RT2 OPERATION:

CORRECT J-1 PILOT CALIBRATION:

Verify using the J-1 Δ P CALIBRATION procedure in this section.

LEAK-TIGHT HIGH PRESSURE SIDE:

Verify using the PRESSURE HOLD TEST procedure in this section.

UNOBSTRUCTED RESTRICTOR AND FILTERS:

Verify using the PLUGGING TEST procedure in this section.

CALIBRATION AND TESTING PROCEDURES:

For routine calibration and testing, the following steps (1 to 7) are to be executed in sequence.

NOTE:

THESE PROCEDURES REQUIRE BETTIS CALIBRATION KIT, PART NO. 930-980. REFER TO APPENDIX A FOR AN ALTERNATE PROCEDURE BASED ON SIMPLIFIED EQUIPMENT. THIS SIMPLIFIED EQUIPMENT IS SPECIFIED IN THE PROCEDURE AND MAY BE SUPPLIED BY THE USER.

1. <u>DISARM SYSTEM</u>

Isolate or disarm controls and equipment downstream of the J1-RT2 output signal to prevent inadvertent operation or alarms (Follow applicable procedures and operating instructions). Depending on where and how this is done, selected downstream controls can be left active. The function of these controls can then be verified when J1-RT2 output signals are generated during the following procedures.

2. CHECK FOR EXTERNAL LEAKS:

While the J1-RT2 system is still pressurized, check for external leaks at all connections using soapy water. Fix any leaks before proceeding.

3. SETUP TEST EQUIPMENT

SEE FIG 2, "SETUP FOR J1-RT2 CALIBRATION AND TESTING WITH CALIBRATION KIT"

CAUTION: DISARM AND DEPRESSURIZE BEFORE ATTEMPTING SERVICE; Close

the PIPELINE TAKE-OFF VALVE and de-pressurize the system by opening

the RATE TANK DRAIN VALVE.

CAUTION: Ensure that contaminants (eg. dust, soapy water, etc.) do not enter at the

HIGH or LOW PRESSURE TEST CONNECTIONS.

 a. Connect HIGH PRESSURE CONNECTION on CALIBRATION KIT PANEL to HIGH PRESSURE TEST CONNECTION on the J1-RT2 MANIFOLD (3/8 tube fitting).

- b. Connect LOW PRESSURE CONNECTION on CALIBRATION KIT PANEL to LOW PRESSURE TEST CONNECTION on the J1-RT2 MANIFOLD (1/4 tube fitting).
- c. Connect PIPELINE CONNECTION on CALIBRATION KIT PANEL to a PIPELINE PRESSURE TAP (or between the PIPELINE TAKE-OFF VALVE and the PIPELINE ISOLATION VALVE).

Ensure: 1. All CALIBRATION KIT PANEL valves are closed except the METERING VALVE which should be near fully open.

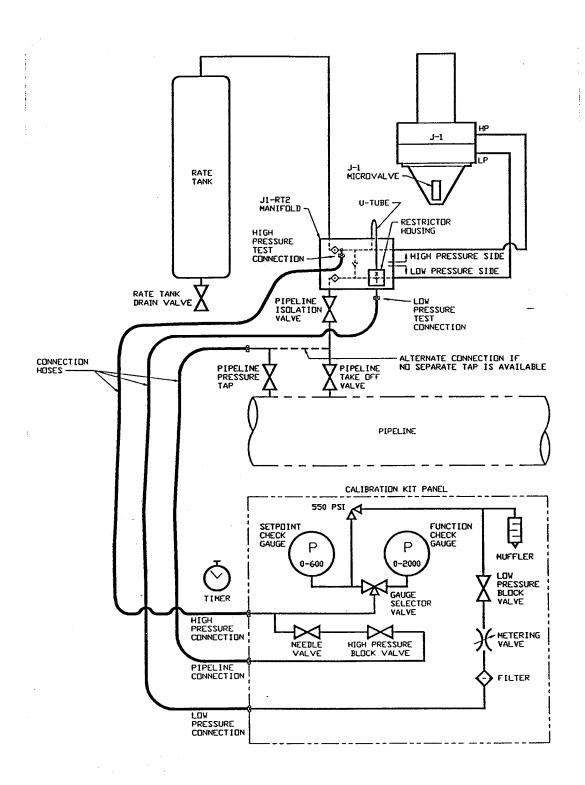
- 2. GAUGE SELECTOR VALVE is set to FUNCTION CHECK.
- 3. All connections are made leak tight.

To pressurize system for leak checking connections:

- Open PIPELINE TAKE OFF VALVE and PIPELINE ISOLATION VALVE
- Open HIGH PRESSURE BLOCK VALVE
- Slowly open CALIBRATION PANEL NEEDLE VALVE allowing system to fill and stabilize

To vent off:

- Close PIPELINE TAKE OFF VALVE
- Open RATE TANK DRAIN VALVE
- Open LOW PRESSURE BLOCK VALVE



SET-UP FOR J1-RT2 CALIBRATION AND TESTING WITH CALIBRATION KIT

4. J-1 ΔP CALIBRATION

- a. Remove U-TUBE and install caps on fittings.
- b. Open the LOW PRESSURE SIDE to atmosphere by fully opening the METERING VALVE and the LOW PRESSURE BLOCK VALVE. Close the RATE TANK DRAIN VALVE and PANEL NEEDLE VALVE. Set the GAUGE SELECTOR VALVE to the SETPOINT CHECK GAUGE.
- c. Open the HIGH PRESSURE BLOCK VALVE and slowly increase pressure on the HIGH PRESSURE SIDE using the NEEDLE VALVE. Note the reading on the SETPOINT CHECK GAUGE when the J-1 switches (ie. MICROVALVE toggles). Close NEEDLE VALVE after J-1 switches.
- d. Repeat test, vent the HIGH PRESSURE SIDE by closing the NEEDLE VALVE and opening the RATE TANK DRAIN VALVE, and repeat procedure b and c above.
- e. Compare the J-1 switch pressure to the required ΔP^* .
- f. Adjust the J-1 spring load if required (turn adjusting nut FIG 4, item 111) and repeat steps b, c and d until switching occurs at the required ΔP . If the required ΔP is outside the range of the J-1 spring, contact the factory for an alternate.
- * If the required ΔP is unknown or not yet established, use the CALIBRATION CHART to find the ΔP corresponding to the specified/desired rate-of-drop (RoD) and pipeline pressure (P/L). (If the pipeline operates over a wide pressure range, a typical pressure must be selected).

Use of CALIBRATION CHART to find ΔP : Find the specified/desired RoD along the horizontal axis and trace a line upward to where it intersects the specified/desired P/L line (interpolation between P/L lines may be required). From this intersection trace a horizontal line to the vertical axis and read the ΔP value. Refer to comments on the CALIBRATION CHART in Section I.

5. PRESSURE HOLD TEST

- a. Ensure the PIPELINE ISOLATION VALVE is closed. Depressurize the system by venting the RATE TANK (open the RATE TANK DRAIN VALVE). Disconnect the hose from the PIPELINE PRESSURE TAP and PANEL PIPELINE CONNECTION. Re-install plugs at both fittings.
- b. If not done in step 4a then, remove the U-TUBE and install tubing caps on the fittings. CAUTION: Ensure that contaminants (eg. dust, soapy water etc.) do not enter at these fittings. Close the RATE TANK DRAIN VALVE and HIGH PRESSURE BLOCK VALVE. CAUTION: Ensure that plugs have been installed leak tight. Check with soapy water when the system is pressurized in step c. Set the GAUGE SELECTOR VALVE to the SETPOINT CHECK GAUGE.
- c. LOW PRESSURE HOLD TEST: Close the LOW PRESSURE BLOCK VALVE. Pressurize the HIGH PRESSURE SIDE to 20 psi by opening the PIPELINE ISOLATION VALVE (the flow through the check valve will require it to open and reseat at low pressure resulting in a worst case test). Stabilize the pressure reading for one minute then vent the LOW PRESSURE SIDE by opening the LOW PRESSURE BLOCK VALVE (METERING VALVE near fully open). Monitor the SETPOINT CHECK GAUGE for 3 minutes. The maximum allowable pressure loss is 10% of RoD over 3 minutes (eg. if RoD = 20 psi/min then allowable pressure loss over 3 minutes is 2 psi or less).
- d. HIGH PRESSURE HOLD TEST: Close the LOW PRESSURE BLOCK VALVE. Pressurize the HIGH PRESSURE SIDE to 500 psi (or to available P/L if less) by opening the PIPELINE ISOLATION VALVE. Stabilize the pressure reading for one minute then vent the LOW PRESSURE SIDE by opening the LOW PRESSURE BLOCK VALVE and metering valve is nearly full open. Monitor the SETPOINT CHECK GAUGE for 3 minutes. The maximum allowable pressure loss is 10% of RoD over 3 minutes (see example in step c above).

e. If the maximum allowable pressure loss rates are exceeded, there is a leak in the HIGH PRESSURE SIDE which must be traced and fixed. A failure of the LOW PRESSURE HOLD TEST is likely due to a faulty check valve. A failure of the HIGH PRESSURE HOLD TEST is likely due to leaking tube fittings, valves or internal leakage through the J-1 diaphragm or the check valve (refer to Section VI, MAINTENANCE PROCEDURES). Depressurize the system by venting the RATE TANK (open the RATE TANK DRAIN VALVE).

6. PLUGGING TEST

- a. Ensure the PIPELINE ISOLATION VALVE is closed and the system is depressurized (ie. the RATE TANK DRAIN VALVE is open).
- b. Re-install the U-TUBE. Ensure that these tube connections are leak tight as they are on the HIGH PRESSURE SIDE. Check with soapy water after the system is pressurized. CAUTION: Use minimal torque when remaking U-TUBE connections to extend tube life.
- c. Close the RATE TANK DRAIN VALVE and LOW PRESSURE BLOCK VALVE. Ensure the METERING VALVE is near fully open, the HIGH PRESSURE BLOCK VALVE is closed and the GAUGE SELECTOR VALVE is on SETPOINT CHECK GAUGE.
- d. Pressurize the system to 300 psi by opening the PIPELINE ISOLATION VALVE. Stabilize the pressure for one minute (If pressure will not stabilize, there is a leak in the system which must be fixed before running the test. See item 5, PRESSURE HOLD TEST).
- e. Open the LOW PRESSURE BLOCK VALVE and simultaneously start TIMER.
- f. Record pressure reading at 90 seconds and close the LOW PRESSURE BLOCK VALVE.
- g. Compare this to the appropriate MAXIMUM END PRESSURE value in the table below. If the end pressure is above the maximum, there is plugging or obstruction of the restrictor or filters (refer to Section VI, MAINTENANCE PROCEDURES).

J1-RT2 TYPE NO.	MAXIMUM END PRESSURE (psig)		
	NATURAL GAS	AIR, NITROGEN	
050416	172	189	
100416	226	237	
200416	260	267	
400416	280	283	

7. <u>RESTORE THE UNIT TO OPERATING CONDITION</u> (or proceed to the FUNCTION CHECK procedure, Section IV.)

CAUTION: Ensure that all connections are leak tight, especially on the HIGH PRESSURE SIDE (ie. HIGH PRESSURE TEST CONNECTION plug, U-TUBE and RATE TANK DRAIN VALVE plug. Check with soapy water when the system is repressurized).

SECTION IV FUNCTION CHECK

The J1-RT2 function and calibration can be checked in the field by doing RoD SIMULATION RUNS. Using PIPELINE PRESSURE repeat runs at different RoDs to approximate the "SETPOINT RoD" (ie. the RoD which generates just enough ΔP to activate the J-1 pilot at a particular P/L).

This process will give two RoD values:

- The upper value: the lowest RoD at which the J-1 switched.
- The lower value: the highest RoD at which the J-1 did not switch.

The closer the two values are the more accurately the SETPOINT RoD is determined. Each value of RoD will have a corresponding value of P/L which is also recorded.

NOTE: The THREE REQUIREMENTS FOR CORRECT J1-RT2 OPERATION (see Section III) are the first priority and must be met for this function check to be valid.

PROCEDURE:

1. <u>DISARM SYSTEM</u> (See Section III, step 1)

2. <u>SETUP TEST EQUIPMENT</u>

This is the same as Section III, step 3, except the hose connecting the PIPELINE PRESSURE TAP to the CALIBRATION KIT PANEL PIPELINE CONNECTION is not required, and the RATE TANK DRAIN VALVE is closed and plugged. Set the GAUGE SELECTOR VALVE to FUNCTION CHECK GAUGE.

3. RoD SIMULATION RUNS

Each run must have the same starting pressure (ie. P@T = 0:00). Use a starting pressure which is equal to or slightly less than typical pipeline operating pressure (Using the same starting pressure for future function checks will allow direct comparison of data). Use the table below to find the appropriate value for T1 and T2.

SECTION IV FUNCTION CHECK - continued

Each RoD SIMULATION RUN consists of the following:

- a. Using available PIPELINE PRESSURE charge the system to the starting pressure by opening the PIPELINE ISOLATION VALVE (Ensure the LOW PRESSURE BLOCK VALVE is closed).
- b. Close the PIPELINE ISOLATION VALVE and set the METERING VALVE. (The METERING VALVE setting controls RoD and must be determined by trial and error).
- c. Stabilize at the starting pressure for at least one minute.
- d. Open the LOW PRESSURE BLOCK VALVE and start the TIMER (T=0:00) simultaneously.
- e. Record P@T=T1 and T2. Note whether and when the J-1 switches.
- f. After T=T2, close the LOW PRESSURE BLOCK VALVE to end the run.
- g. To calculate the RoD for the run use:

$$RoD=[(P@T=T1)-(P@T=T2)]/2.$$

To calculate the approximate P/L for the run use:

P/L=(P@T=T1)-(J-1
$$\Delta$$
P setting).

h. If the J-1 switched, reduce RoD (ie. close down metering valve slightly) for the next run. If the J-1 did not switch, increase RoD for the next run.

J1-RT2 TYPE NO.	T1	T2
050416	0:30	2:30
100416	1:00	3:00
200416	2:00	4:00
400416	3:00	5:00

SECTION IV FUNCTION CHECK - continued

This procedure can be used even if the available PIPELINE PRESSURE (ie. starting pressure for each run) is below normal. However, since all the variables are interdependent, the setpoint RoD and P/L values will be correspondingly reduced so they cannot be directly compared to "spec", or previously established baseline values.

The METERING VALVE used in the FUNCTION CHECK procedure has a very small annular gap between the orifice and the needle. Due to the this and the large pressure drop across it, freeze-off may occur when the ambient temperature is low or when the pipeline gas dew point is high. This will cause difficulty in adjusting and achieving a continuous RoD in the RoD SIMULATION RUNS. The remedy is to apply heat to the body of the METERING VALVE, either by hand contact, or a chemical or electric heating pad or similar device, at $80^{\circ}\text{C} \pm 20^{\circ}\text{C}$.

4. RESTORE THE UNIT TO OPERATING CONDITION

Depressurize and disconnect test equipment. Install caps on HIGH PRESSURE and LOW PRESSURE TEST CONNECTIONS. CAUTION: Ensure that all connections are leak tight, especially on the HIGH PRESSURE SIDE (ie. HIGH PRESSURE TEST CONNECTION plug, U-TUBE and RATE TANK DRAIN VALVE plug). Check with soapy water when system is re-pressurized.

SECTION V TROUBLE-SHOOTING

In general, the J1-RT2 system will be trouble free as long as the "THREE REQUIREMENTS FOR CORRECT OPERATION" are met (refer to Section III).

In case of trouble the procedures below should help to isolate the problem. See also the remainder of this manual for correct operating procedures and detailed description of components.

Re-check assembly and operating procedures if problems arise immediately after shutdown for maintenance or calibration.

CAUTION: Before doing any work on the system, refer to SECTION VI, MAINTENANCE

PROCEDURES, item 1 "DISARM AND DEPRESSURIZE BEFORE

REMOVAL/DISASSEMBLY"

PROBLEM		CAUSE		REMEDY
A) J1-RT2 FAILS TO ACTIVATE on ESD condition (high RoD)	1.	J-1 diaphragm cracked or leaking	1.	Replace diaphragm; refer to Section VI, item 8
	2.	External leakage (Confirm by doing PRESSURE HOLD TEST)	2.	Check and correct
	3.	By-pass check valve inside MANIFOLD is leaking (confirm by doing PRESSURE HOLD TEST)	3.	Check if there is any foreign material at the poppet of the check valve; refer to Section VI, item 5
	4.	Dirty filters	4.	Clean or replace filters; refer to Section VI, item 3 and 4
B) J1 PILOT FAILS TO ACTIVATE on ESD condition (high RoD, high ΔP)	1.	J-1 setpoint too high	1.	Refer to Section III, item 4
	2.	J-1 diaphragm stiff or shaft jammed (confirm by removing spring and checking for 1/4" free travel)	2.	Clean and lubricate parts, replace diaphragm, refer to Section VI, item 8

SECTION V TROUBLESHOOTING - continued

PROBLEM	CAUSE	REMEDY
C) NO SIGNAL OUTPUT FROM J-1 MICROVALVE on ESD condition.	M 1. Insufficient lift on valve (travel of microvalve)	 See J-1 pilot drawing; check the bracket bolt tightness and trigger bolt adjustment; refer to Section VI, item 7
	Microvalve is clogged by foreign material	2. Clean valve passages
	Supply filters are dirty, flow rate is then restricted	3. Clean filter elements
	 Regulator setting is incorrect (low pressure output only) 	Check regulator setpoint, adjust if necessary
D) SYSTEM ACTIVATES in absence of ESD condition (false signal)	1. J-1 setpoint too low	Refer to Section III, item 4
	 P/L is less than RATE TANK PRESSURE while attempting to reset 	2. Allow to stabilize
	 Low RoD develops high ΔP due to clogged restrictor 	 Check and clean restrictor; refer to Section VI, item 6

SECTION VI MAINTENANCE PROCEDURES

1. DISARM AND DEPRESSURIZE BEFORE REMOVAL/DISASSEMBLY.

The following steps are to be carried out when removing/disassembling any part of the linebreak system, for reasons of safety.

- a. Isolate or disarm downstream controls and equipment to prevent inadvertent operation or alarms.
- b. Close isolation valve at the pipeline (ie. upstream of all linebreak system components).
- c. Depressurize the system by opening the RATE TANK DRAIN VALVE.

2. STANDARD PRACTICES FOR MAINTENANCE

- a. Clean around any parts to be removed before removal.
- b. Note or mark piping or parts orientation before removal to facilitate re-assembly.
- c. Clean all parts before assembly, particularly sealing surfaces.
- d. Lubricate all o-rings and sliding surfaces.
- e. Lubricate all threads to prevent galling.

3. MAINTENANCE OF MANIFOLD FILTER ELEMENTS (Refer to FIG 6)

To maintain free flow and prevent false shutdowns, the two filter elements in the MANIFOLD should be cleaned, or replaced, at least every six months until service experience indicates a more suitable interval. To do this:

- a. Remove one of the FILTER END PLUGS (on left side of MANIFOLD).
- b. Remove the spring.
- c. Tap or pry filter element lightly on side to break loose from the tapered sealing bore.
- d. Clean the filter element.
- e. Insert the clean filter element into the bore. Tap lightly with smooth faced tool to re-seat the element in tapered bore.
- f. Replace spring and END PLUG. Tighten END PLUG securely.
- g. Repeat 3 through 8 for second filter.

SECTION VI MAINTENANCE PROCEDURES - continued

4. MAINTENANCE OF OPTIONAL PREFILTER (Refer to FIG 3)

An optional prefilter (item 170) upstream of MANIFOLD connection (Port "A") is highly recommended in wet or dirty service to entrap foreign particles and moisture which could cause rapid plugging of the manifold filter elements.

Inspect and/or replace the filter cartridge on the same schedule as the manifold filter elements (refer to item 3). Ensure that the filter body is depressurized before opening.

5. CHECK VALVE REMOVAL/INSPECTION (Refer to FIG 6)

Remove CHECK VALVE RETAINER PLUG and NPT pipe plug at opposite side of MANIFOLD. Push the check valve out using a suitable, non metal tool (to avoid damage or scratches). Check for moisture or debris inside check valve body or between o-ring and poppet. If present, hold the poppet off the seat and clear with compressed air. Check for free movement of the poppet. Inspect the sealing surface in the manifold bore and condition of the external o-ring on the check valve body. If the valve still leaks, the internal o-ring is probably damaged and the valve requires replacement.

6. RESTRICTOR MAINTENANCE (Refer to FIG 6)

To ensure correct operation the RESTRICTOR must be free of obstruction. The manifold filters and recommended prefilter are meant to keep the restrictor clean and dry. However, if plugging is suspected, follow the procedure below:

- a. Remove RESTRICTOR HOUSING from MANIFOLD. (The restrictor cannot be removed from the housing without special tools.)
- b. Soak in solvent for a 24 hour period.
- c. To remove solvent, and provide proper filtering, attach the RESTRICTOR HOUSING to the manifold via the U-TUBE only (ie. do not screw housing into manifold), then blow air through the RESTRICTOR by pressurizing the RATE TANK side of the system.

SECTION VI MAINTENANCE PROCEDURES - continued

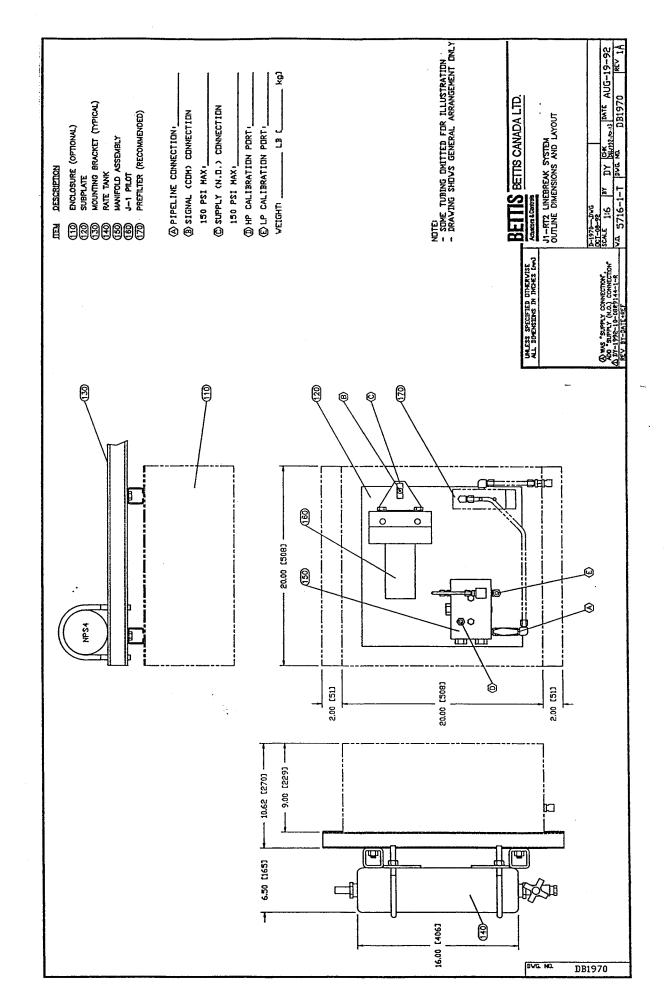
- d. Reinstall RESTRICTOR HOUSING and U-TUBE on the MANIFOLD.
- e. Verify correct installation of the manifold filters (refer to item c in this section).

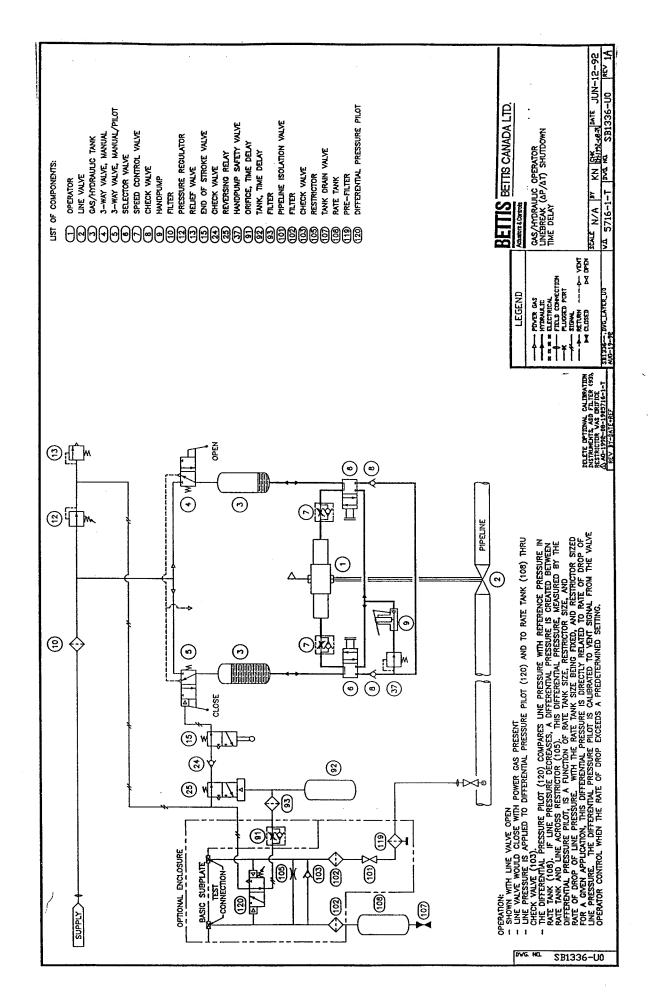
7. <u>J-1 MICROVALVE ALIGNMENT</u> (Refer to FIG 5)

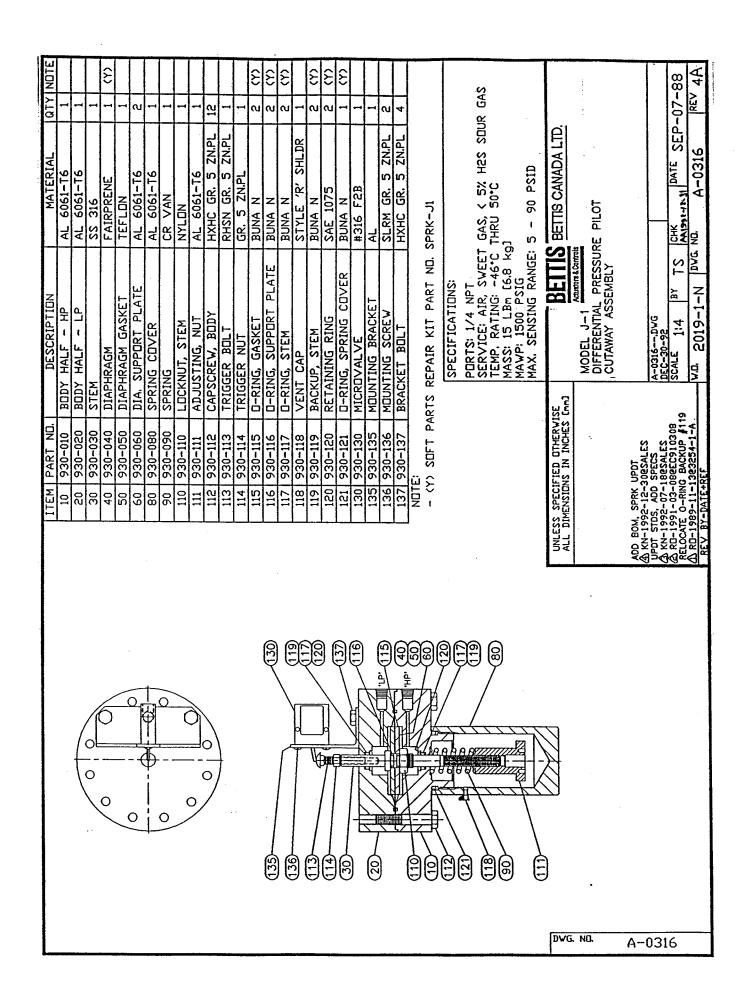
- a. Remove the spring (item 90)
- b. Pressurize the HIGH PRESSURE SIDE to 120 psi. Adjust the trigger bolt outwards until the microvalve (item 130) is triggered. Lock in place with locknut.
- c. The microvalve lever should have approximately 0.010 to 0.032 inches additional over travel. Do not use excessive force on the lever.
- d. Vent the HIGH PRESSURE SIDE and re-install the spring.

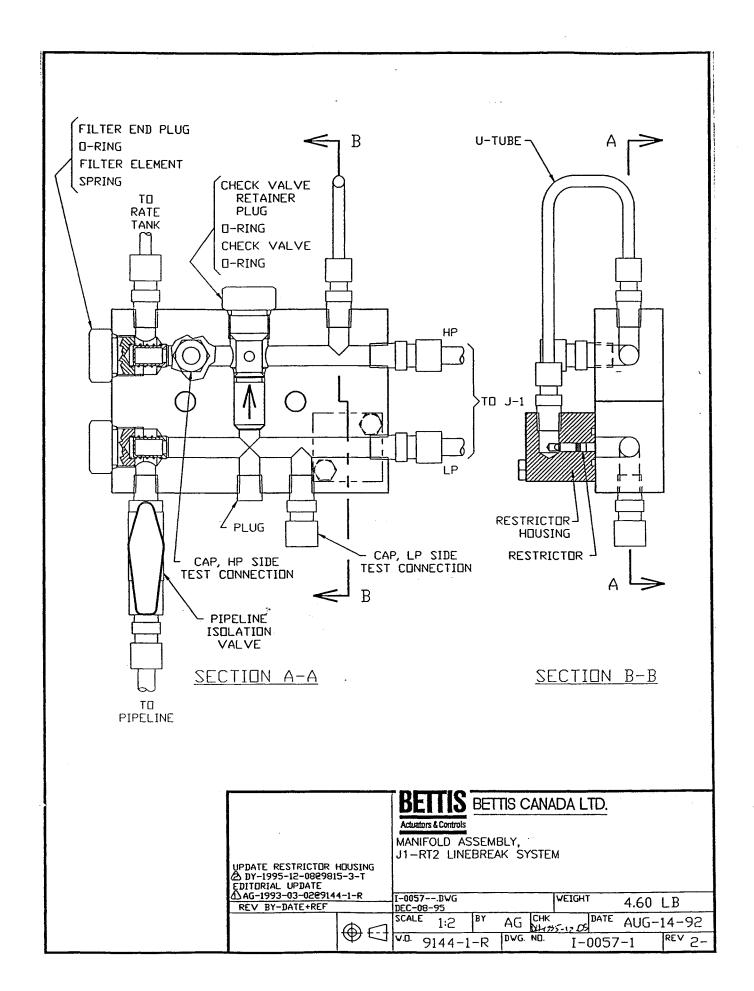
8. <u>J-1 PILOT INSPECTION/MAINTENANCE</u> (Refer to FIG 5)

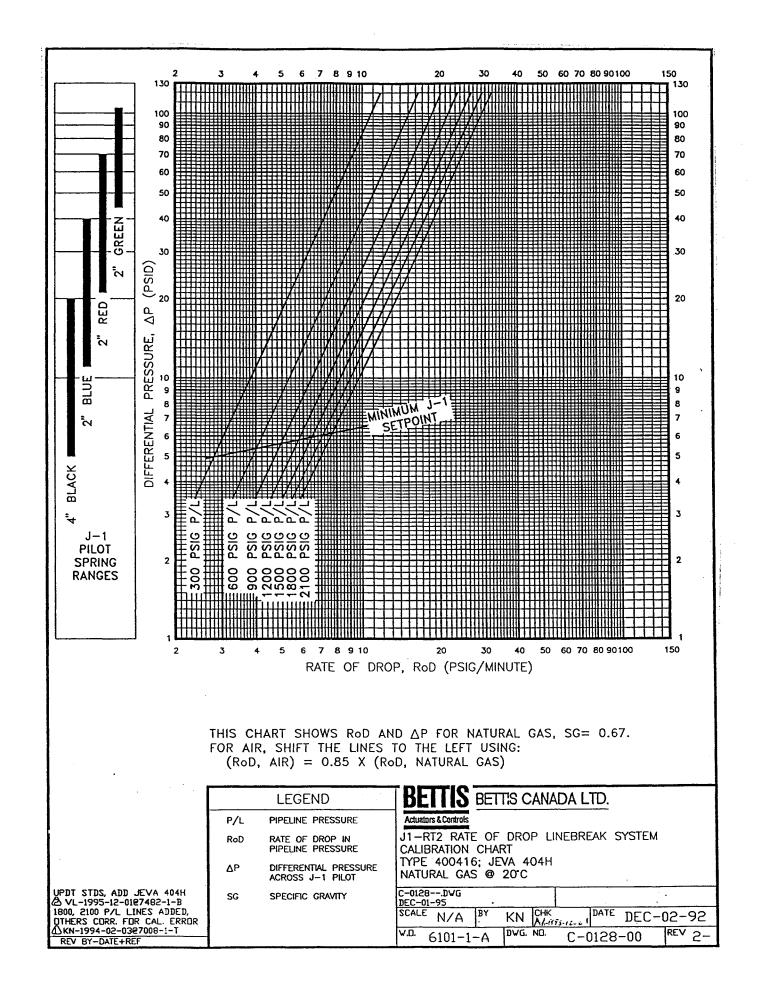
- a. Disconnect the tubes at the HIGH PRESSURE and LOW PRESSURE fittings, remove the J-1 spring and check that the diaphragm mechanism travels from stop to stop (about 1/4" total travel) without binding or catching.
- b. Apply about 100 psi at the HIGH PRESSURE fitting and check for leakage at the LOW PRESSURE fitting. This can be done by installing a tube cap loosely and checking for bubbles with soapy water. Alternatively, a ¼" plastic tube can be connected to the LOW PRESSURE fitting with the free end submerged in c" in water. In either case, there should be no sustained bubbling.
- c. If any problems are detected, obtain a spare parts kit and rebuild.

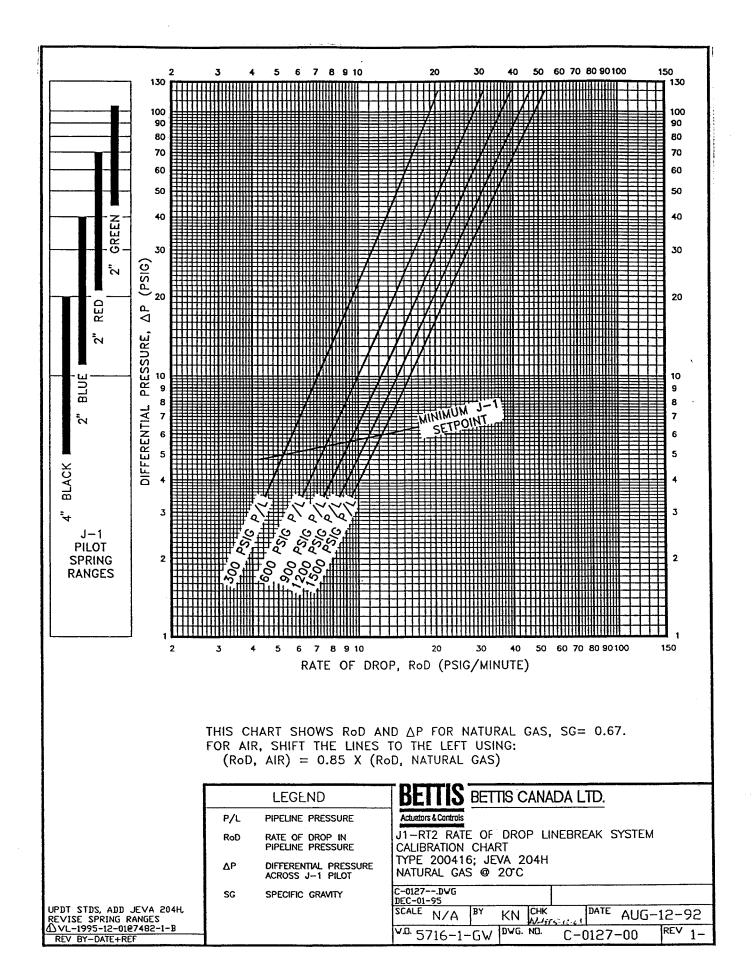


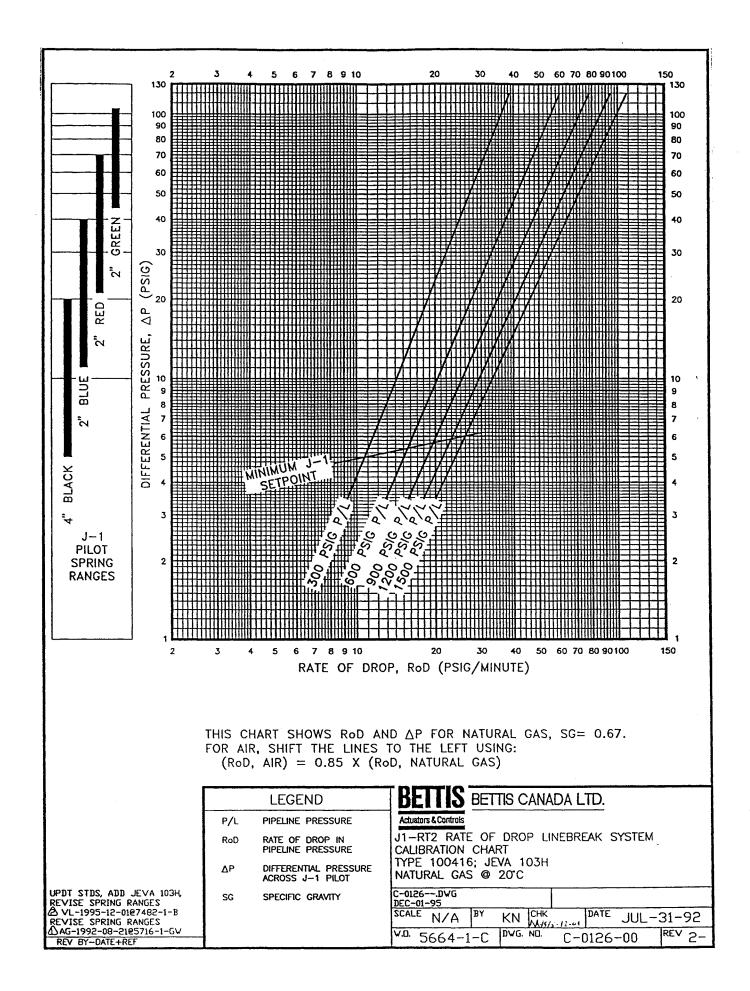












ALTERNATE PROCEDURES FOR SECTION III CALIBRATION AND TESTING

AND SECTION IV FUNCTION CHECK

THESE ALTERNATE PROCEDURES ARE BASED ON SIMPLIFIED TEST EQUIPMENT, SPECIFIED IN THE PROCEDURE, WHICH MAY BE SUPPLIED BY THE USER.

SECTION III CALIBRATION AND TESTING

THREE REQUIREMENTS FOR CORRECT J1-RT2 OPERATION:

CORRECT J-1 PILOT CALIBRATION:

Verify using the J-1 ΔP CALIBRATION procedure in this section.

LEAK-TIGHT HIGH PRESSURE SIDE:

Verify using the PRESSURE HOLD TEST procedure in this section.

UNOBSTRUCTED RESTRICTOR AND FILTERS:

Verify using the PLUGGING TEST procedure in this section.

CALIBRATION AND TESTING PROCEDURES:

For routine calibration and testing, the following steps (1 to 7) are to be executed in sequence.

1. DISARM SYSTEM

Isolate or disarm controls and equipment downstream of the J1-RT2 output signal to prevent inadvertent operation or alarms (Follow applicable procedures and operating instructions). Depending on where and how this is done, selected downstream controls can be left active. The function of these controls can then be verified when J1-RT2 output signals are generated during the following procedures.

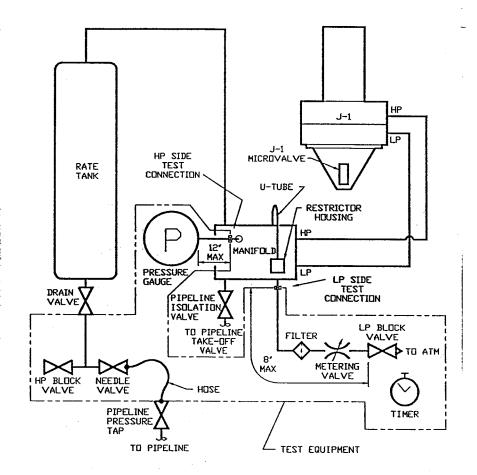
2. CHECK FOR EXTERNAL LEAKS

While the J1-RT2 system is still pressurized, check for external leaks at all connections using soapy water. Fix any leaks before proceeding.

SECTION III CALIBRATION AND TESTING - continued

3. SETUP TEST EQUIPMENT

Close the PIPELINE ISOLATION VALVE. Depressurize the system by opening the RATE TANK DRAIN VALVE. Setup test equipment as shown in the diagram below. CAUTION: Ensure that contaminants (eg. dust, soapy water etc.) do not enter at the HIGH PRESSURE and LOW PRESSURE SIDE TEST CONNECTIONS. All connections must be leak tight. CAUTION: When PIPELINE PRESSURE is greater than the range of the PRESSURE GAUGE, use extreme care when opening valves to avoid over pressurizing.



TEST EQUIPMENT SPECIFICATIONS:

- -- PRESSURE GAUGE: 0-1000 PSI RANGE (MAX), 2.5 PSI/DIV (PREFERRED)
 -- METERING VALVE: .031" ORIFICE, 1' STEM TAPER, VERNIER HANDLE (PREFERRED)
 -- FILTER: 0.5 MICRON, INLINE, 1/4" CONNECTIONS
 -- BLOCK VALVES: 1/4" NOMINAL, 1/4 TURN, BUBBLE TIGHT
 -- NEEDLE VALVE: 1/4" NOMINAL, BUBBLE TIGHT

- HOSE: HIGH PRESSURE
- TIMER: STOPWATCH (PREFERRED)

SET-UP FOR J1-RT2 CALIBRATION AND TESTING

SECTION III CALIBRATION AND TESTING - continued

4. <u>J-1 ΔP CALIBRATION</u>

- a. Open the LOW PRESSURE SIDE to atmosphere by fully opening the METERING VALVE and the LOW PRESSURE BLOCK VALVE.
- b. Slowly increase pressure on the HIGH PRESSURE SIDE using the NEEDLE VALVE, and note the reading on the PRESSURE GAUGE when the J-1 switches (ie.
 MICROVALVE toggles). (When the HIGH PRESSURE SIDE is pressurized there will be a small flow through the restrictor).
- c. After the J-1 switches, shut the NEEDLE VALVE and vent the HIGH PRESSURE SIDE by opening the HIGH PRESSURE BLOCK VALVE.
- d. Compare the J-1 switch pressure to the required ΔP^* .
- e. Adjust the J-1 spring load if required (turn adjusting nut FIG 4, item 111) and repeat steps b, c and d until switching occurs at the required ΔP . If the required ΔP is outside the range of the J-1 spring, contact the factory for an alternate.
- * If the required ΔP is unknown or not yet established, use the CALIBRATION CHART to find the ΔP corresponding to the specified/desired RoD and P/L. (If the pipeline operates over a wide pressure range, a typical pressure must be selected).

Use of CALIBRATION CHART to find ΔP : Find the specified/desired RoD along the horizontal axis and trace a line upward to where it intersects the specified/desired P/L line (interpolation between P/L lines may be required). From this intersection trace a horizontal line to the vertical axis and read the ΔP value. Refer to comments on the CALIBRATION CHART in Section I.

5. PRESSURE HOLD TEST

 Ensure the PIPELINE ISOLATION VALVE is closed. Depressurize the system by venting the RATE TANK (open the DRAIN VALVE and HIGH PRESSURE BLOCK VALVE).

SECTION III CALIBRATION AND TESTING - continued

- b. Remove the U-TUBE and install tubing caps on the fittings (the cap on the HIGH PRESSURE SIDE must be installed leak tight to pass the pressure hold tests). CAUTION: Ensure that contaminants (eg. dust, soapy water etc.) do not enter at these fittings as they are internal to the manifold filters. Close the RATE TANK DRAIN VALVE, leaving the HIGH PRESSURE BLOCK VALVE open.
- c. LOW PRESSURE HOLD TEST: Close the LOW PRESSURE BLOCK VALVE. Pressurize the HIGH PRESSURE SIDE TO 20 psi by opening the PIPELINE ISOLATION VALVE (the flow through the check valve will require it to open and reseat at low pressure resulting in a worst case test). Stabilize the pressure reading for one minute then vent the LOW PRESSURE SIDE by opening the LOW PRESSURE BLOCK VALVE. Monitor the PRESSURE GAUGE for 3 minutes. The maximum allowable pressure loss is 10% of RoD over 3 minutes (eg. if RoD = 20 psi/min then allowable pressure loss over 3 minutes is 2 psi or less).
- d. HIGH PRESSURE HOLD TEST: Close the LOW PRESSURE BLOCK VALVE. Pressurize the HIGH PRESSURE SIDE to 500 psi (or to available P/L if less) by opening the PIPELINE ISOLATION VALVE. Stabilize the pressure reading for one minute then vent the LOW PRESSURE SIDE by opening the LOW PRESSURE BLOCK VALVE. Monitor the pressure gauge for 3 minutes. The maximum allowable pressure loss is 10% of RoD over 3 minutes (see example in step c above).
- e. If the maximum allowable pressure loss rates are exceeded, there is a leak in the HIGH PRESSURE SIDE which must be traced and fixed. A failure of the LOW PRESSURE HOLD TEST is likely due to a faulty check valve. A failure of the HIGH PRESSURE HOLD TEST is likely due to leaking tube fittings, valves or internal leakage through the J-1 diaphragm or the check valve (refer to Section VI, MAINTENANCE PROCEDURES). Depressurize the system by venting the RATE TANK and re-install the U-TUBE.
- f. Ensure that these tube connections are leak tight as they are on the HIGH PRESSURE SIDE. Check with soapy water after the system is pressurized.

SECTION III CALIBRATION AND TESTING - continued

6. PLUGGING TEST

- a. Ensure the PIPELINE ISOLATION VALVE is closed and the system is depressurized (ie. the RATE TANK DRAIN VALVE and HIGH PRESSURE BLOCK VALVE are open).
- b. Close the RATE TANK DRAIN VALVE and LOW PRESSURE BLOCK VALVE, and fully open the METERING VALVE (leave the HIGH PRESSURE BLOCK VALVE open).
- c. Pressurize the system to 300 psi by opening the PIPELINE ISOLATION VALVE. Stabilize the pressure for one minute (If pressure will not stabilize, there is a leak in the system which must be fixed before running the test. See item 5, PRESSURE HOLD TEST).
- d. Open the LOW PRESSURE BLOCK VALVE and simultaneously start TIMER.
- e. Record pressure reading at 90 seconds and close the LOW PRESSURE BLOCK VALVE.
- f. Compare this to the appropriate MAXIMUM END PRESSURE value in the table below. If the end pressure is above the maximum, there is plugging or obstruction of the restrictor or filters (refer to Section VI, MAINTENANCE PROCEDURES).

J1-RT2 TYPE NO.	MAXIMUM END PRESSURE (psig)		
	NATURAL GAS	AIR, NITROGEN	
050416	172	189	
100416	226	237	
200416	260	267	
400416	280	283	

7. Restore the unit to operating condition or proceed to the FUNCTION CHECK procedure, Section IV. Ensure that all remade connections are leak tight, especially on the HIGH PRESSURE SIDE (ie. cap for HIGH PRESSURE TEST CONNECTION and plug at the RATE TANK DRAIN VALVE. Check with soapy water).

SECTION IV FUNCTION CHECK

The J1-RT2 function and calibration can be checked in the field by doing RoD SIMULATION RUNS. Using P/L repeat runs at different RoDs to approximate the "SETPOINT RoD" (ie. the RoD which generates just enough ΔP to activate the J-1 pilot at a particular P/L).

This process will give two RoD values:

- The upper value: the lowest RoD at which the J-1 switched.
- The lower value: the highest RoD at which the J-1 did not switch.

The closer the two values are the more accurately the SETPOINT RoD is determined. Each value of RoD will have a corresponding value of P/L which is also recorded.

NOTE: The THREE REQUIREMENTS FOR CORRECT J1-RT2 OPERATION (see Section III) are the first priority and must be met for this function check to be valid.

PROCEDURE:

1. <u>DISARM SYSTEM</u> (See Section III, item 1)

2. <u>SETUP TEST EQUIPMENT</u>

This is the same as Section III, item 3 except the HIGH PRESSURE BLOCK VALVE, NEEDLE VALVE and HOSE are removed, and the RATE TANK DRAIN VALVE is closed and plugged. If the normal PIPELINE PRESSURE range exceeds the range of the gauge used in Section III (ie. 0-1000 psi) then install a gauge of suitable range with resolution of no greater than 10 psi/div.

3. RoD SIMULATION RUNS

Each run must have the same starting pressure (ie. P@T = 0:00). Use a starting pressure which is equal to or slightly less than typical pipeline operating pressure (Using the same starting pressure for future function checks will allow direct comparison of data). Use the table below to find the appropriate value for T1 and T2.

SECTION IV FUNCTION CHECK - continued

Each RoD SIMULATION RUN consists of the following:

- using available PIPELINE PRESSURE, charge the system to the starting pressure by opening the PIPELINE ISOLATION VALVE (Ensure the LOW PRESSURE BLOCK VALVE is closed).
- b. Close the PIPELINE ISOLATION VALVE and set the METERING VALVE. (The METERING VALVE setting controls RoD and must be determined by trial and error).
- c. Stabilize at the starting pressure for at least one minute.
- d. Open the LOW PRESSURE BLOCK VALVE and start the TIMER (T=0:00) simultaneously.
- e. Record P@T=T1 and T2. Note whether and when the J-1 switches.
- f. After T=T2, close the LOW PRESSURE BLOCK VALVE to end the run.
- g. To calculate the RoD for the run use:

$$RoD=[(P@T=T1)-(P@T=T2)]/2.$$

To calculate the approximate P/L for the run use:

P/L=(P@T=T1)-(J-1
$$\Delta$$
P setting).

h. If the J-1 switched, reduce RoD (ie. close down metering valve slightly) for the next run. If the J-1 did not switch, increase RoD for the next run.

J1-RT2 TYPE NO.	T1	T2
050416	0:30	2:30
100416	1:00	3:00
200416	2:00	4:00
400416	3:00	5:00

SECTION IV FUNCTION CHECK - continued

This procedure can be used even if the available PIPELINE PRESSURE (ie. starting pressure for each run) is below normal. However, since all the variables are interdependent, the setpoint RoD and P/L values will be correspondingly reduced so they cannot be directly compared to "spec", or previously established baseline values.

4. RESTORE THE UNIT TO OPERATING CONDITION

Depressurize system and disconnect test equipment. Install caps on HIGH PRESSURE and LOW PRESSURE TEST CONNECTIONS. CAUTION: Ensure that all connections are leak tight especially on the HIGH PRESSURE SIDE (ie. HIGH PRESSURE TEST CONNECTION plug, U-TUBE and RATE TANK DRAIN VALVE plug). Check with soapy water when system is re-pressurized.